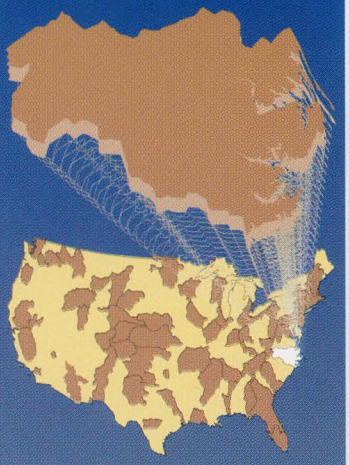
U.S. Geological Survey

National Water-Quality Assessment Program

Albemarle-Pamlico Study Unit



National NAWQA Units
(Shown in Brown)

Open-File Report 95-164

The Albemarle-Pamlico Drainage National Water-Quality Assessment Study: ***Background and Design***

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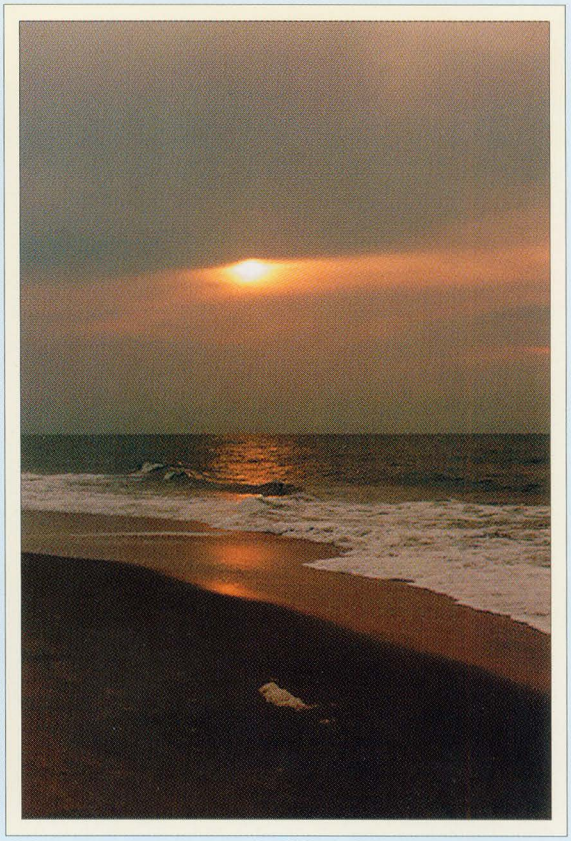
Gerard McMahon

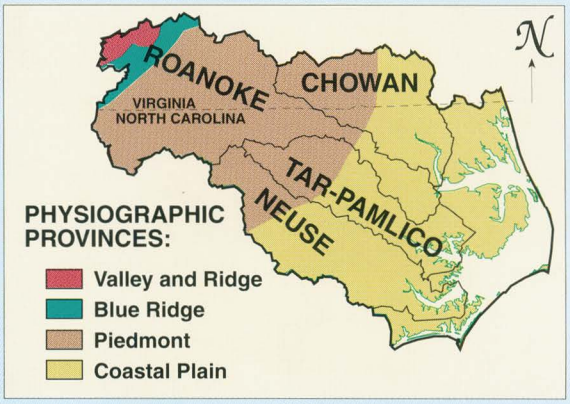
The Albemarle-Pamlico Drainage National Water-Quality Assessment Study: ***Background and Design***

Top: Nitrogen damage to lawn... Bottom: Rural agriculture...



All drain to the sea...

The Albemarle-Pamlico Study Unit is one of 20 National Water-Quality Assessment (NAWQA) studies begun in 1991 by the U.S. Geological Survey (USGS) to assess the Nation's water quality. One of the missions of the USGS is to assess the quantity and quality of the Nation's water resources. The NAWQA program was established to help accomplish this mission. The Albemarle-Pamlico Study Unit, located in Virginia and North Carolina, drains an area of about 28,000 square miles. Four major rivers, the Chowan, the Roanoke, the Tar-Pamlico and the Neuse, all drain into the Albemarle-Pamlico Sound in North Carolina. Four physiographic regions (areas of homogeneous climatic, geologic, and biological characteristics), the Valley and Ridge, Blue Ridge, Piedmont and Coastal Plain Physiographic Provinces are included within the Albemarle-Pamlico Study Unit.



Until 1991, there was no single program that could answer the question, "Are the Nation's ground and surface waters getting better, worse, or are they staying the same?" A program was needed to evaluate water quality by using standard techniques to allow assessment of water quality at local, regional, and national scales. The NAWQA Program was implemented to answer questions about the Nation's water quality using consistent and comparable methods. A total of 60 basins, or study units, will be in place by 1997 to assess the Nation's water quality.

BASIS FOR THE STUDY: WATER-QUALITY ISSUES

The underlying basis for the NAWQA program is concern by Congress about possible degradation of the Nation's ground and surface waters. Chemical and biological characteristics of water must be carefully measured through monitoring to determine if a water-quality problem exists or not. Long-term monitoring is required to detect possible water-quality deterioration through changes in land use, wastewater inputs to streams, or climate. The principal idea behind water-quality monitoring is to allow detection of water-quality problems before they become serious and possibly economically devastating. If problems are detected early enough, then changes in land use or waste disposal practices can be made to prevent further degradation. If no problem is detected, then no management change or regulation may be necessary.

Although a variety of potential water-quality contaminants exists, nutrient and pesticide contamination of ground and surface water were identified by many Federal and State agencies as principal national issues. The Albemarle-Pamlico NAWQA, like other NAWQA studies begun in 1991, focused on these two principal national issues. A Liaison Committee composed of representatives from local, Federal, State, and private organizations, that advises the Albemarle-Pamlico NAWQA staff, provided the following additional issues and concerns. A list of the names of individuals on the Albemarle-Pamlico Liaison Committee can be obtained from the contact person indicated at the end of this report.

Eutrophication of Coastal Sounds

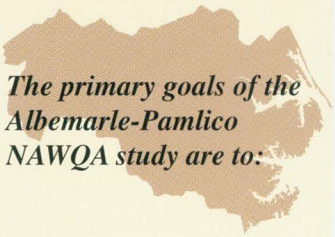
The Albemarle-Pamlico Sound is the second largest estuarine system in the United States. The Sound historically has been a productive nursery for many kinds of fish and shellfish, and has provided favorable habitat for water fowl. During the last 100 years, however, and particularly the last 30, the Sound has lost a large amount of its original productivity. Principal reasons for these changes have been attributed to inflow of nutrients from surface water and ground water.

Point and Nonpoint Sources of Nutrients

What is responsible for polluting streams, lakes, and sounds in the Albemarle-Pamlico Drainage? Point sources from cities and industries discharging wastes from pipes or lagoons into streams? Nonpoint sources from agriculture losing pesticides and fertilizers with runoff originating from plowed and planted fields? Or residential and commercial areas delivering nutrients from lawn fertilizers and septic tanks to ground and surface water? The atmosphere? The answer is, to some extent, all of these. It is important to understand the relative contribution of each to allow effective ways to control water-quality degradation.

Sedimentation in Streams

The Earth's surface is continually being eroded chemically and physically and the residue is carried to the oceans. How fast it erodes, however, depends on many factors, including land use, steepness of the terrain, soil type, and pattern and distribution of the rainfall.



The primary goals of the Albemarle-Pamlico NAWQA study are to:

***(1)* Assess the distribution and occurrence of selected organic chemical compounds, inorganic chemicals and trace elements, and characteristic biological communities in surface and ground water;**

***(2)* Provide a basis for evaluating water-quality trends through time; and**

***(3)* Determine causal relations between land use and other factors and water quality.**

The Coastal Plain is nearly flat and is not as susceptible to erosion compared to the steeper slopes of the Piedmont. Sediment causes problems for fish and shellfish by interfering with ventilation of eggs and respiration of organisms. Sediment also absorbs trace elements and nutrients like phosphorus, which can cause toxicity and algal-growth problems when deposited in the Sounds.

Pesticides

Many pesticides are used in growing crops. It is important to understand where, at what concentrations, and under what conditions pesticides occur in the environment. Until now, there has been little nationally comparable information on general occurrence of pesticides in ground and surface water.

STUDY DESIGN

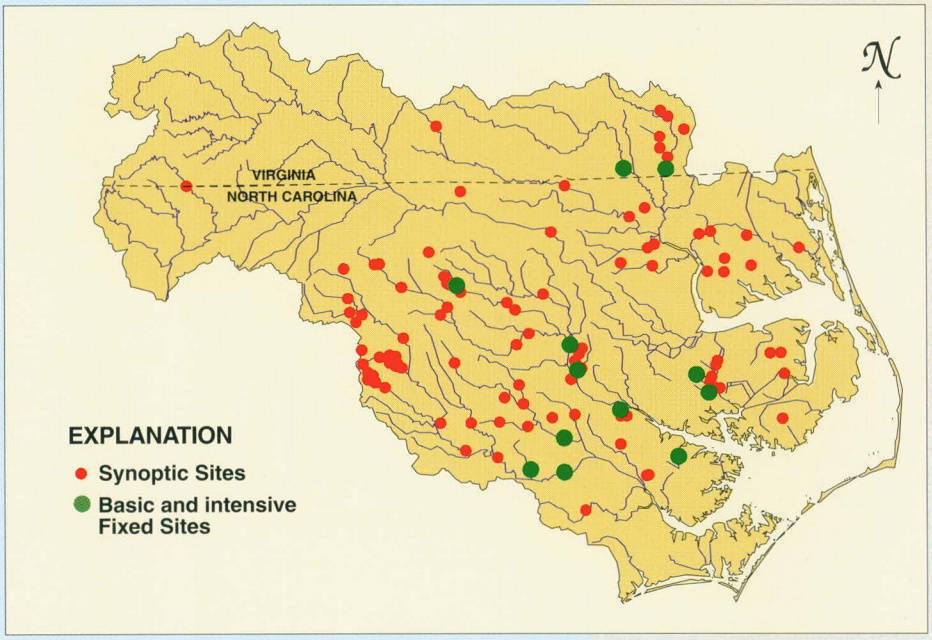
In general, all NAWQA studies have several common characteristics. Data are collected according to nationally consistent methods. The program is intended to exist for decades so that enough data of known quality can be collected to evaluate water-quality trends. Initially, available data are evaluated to guide the field data-collection activities. Ground-water, surface-water, and biological data are collected intensively for 3-4 years (high-intensity phase), monitored at a minimal level for 6 years (low-intensity phase), then again collected intensively, thereby starting another monitoring cycle. This general design is intended to accomplish each of the three overall objectives of NAWQA, as stated earlier.

The NAWQA program is unique in that it attempts to link findings from many different scales: local (a few square miles), regional (a few hundred to a few thousand square miles), and national (thousands to hundreds of thousands of square miles). The ground-water, surface-water, and ecological studies are conducted at these various scales to accomplish an understanding of water-quality problems and to meet the needs of planners, farmers, private landowners, regulatory personnel, and scientists at the local, regional, and national levels. Partnerships and cooperative studies between agencies can most effectively meet these needs.

The following discussions describe surface-water, ecological, and ground-water components of the Albemarle-Pamlico NAWQA Study. The basic design described below is similar to all NAWQA study units nationwide.

Surface Water

Surface-water station types are named, for conceptual and planning purposes, according to their function. The function of these station types relates primarily to monitoring in time and space. Major ions, nutrients, and pesticides are sampled at surface-water stations.



Basic fixed and intensive fixed sites refer to the frequency that the sites are sampled. These sites are used to characterize variation of water quality through time. The Albemarle-Pamlico Study Unit, like other NAWQA Study Units, has eight basic fixed and four intensive fixed sites. As suggested by the name, the basic fixed site is sampled on a regular basis, usually monthly, for the duration of the high-intensity phase monitoring. The intensive fixed sites are monitored frequently, at least for 1 year, to characterize short-term variations of water quality. Intensive fixed sites can be sampled weekly or more frequently.

Basic fixed or intensive fixed sites can be either *indicator or integrator* sites. Indicator sites are selected to represent certain land uses that could be related to water-quality characteristics. If relations between water quality and land use can be identified, then managers can determine whether a problem is likely to exist in similar land-use areas.

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Open-File Report 95-164

Indicator sites are located in relatively small drainage areas (less than 100 square miles) that are typically dominated by one or two land uses to segregate effects from differing land-use practices. *Integrator sites* are established at points downstream in large drainage basins that collect water from thousands of square miles with multitudes of land uses. These sites reflect impacts from all land uses in the basin.

Synoptic sites are sampled periodically to obtain information from many temporary sites. Data from synoptic sites allow investigators to assess how representative the few intensive or basic fixed sites are of streams in the study area.

Ecology

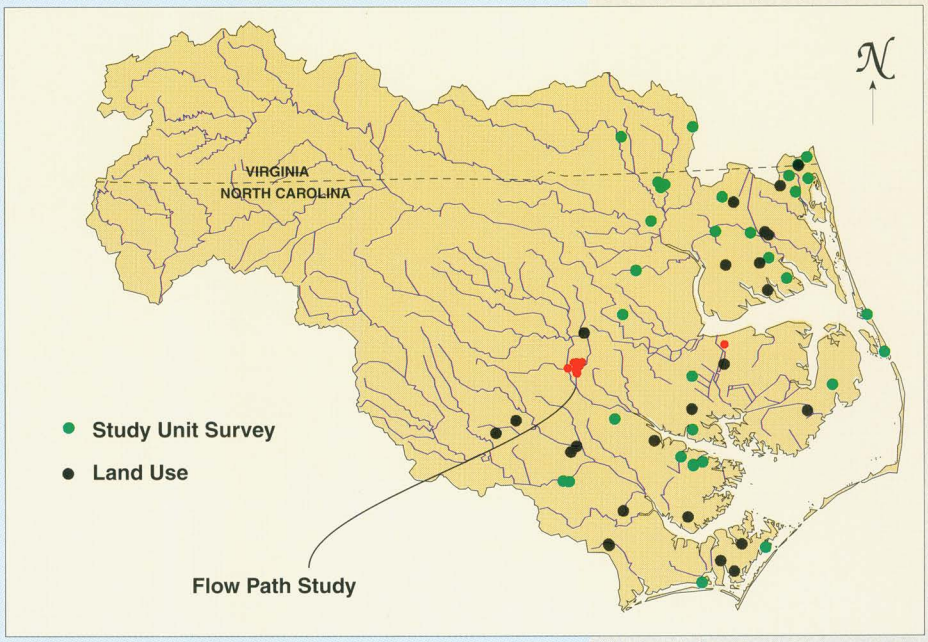
Ecological studies are conducted in concert with the surface-water and ground-water sampling activities. At the beginning of the 3-year intensive sampling phase, sites are sampled for trace elements and organic compounds in tissues and bed sediments. After this initial work, the ecological studies consist of sampling at basic fixed and intensive fixed sites to gain insight into ecological variability over time. Sampling is also conducted on a synoptic basis to evaluate spatial variability and possible differences with respect to various land uses. Fish, algae, and benthic invertebrates are collected at all basic fixed and intensive fixed sites. Synoptic surveys include sampling for selected organisms, depending on the particular purpose of the survey.

Ground Water

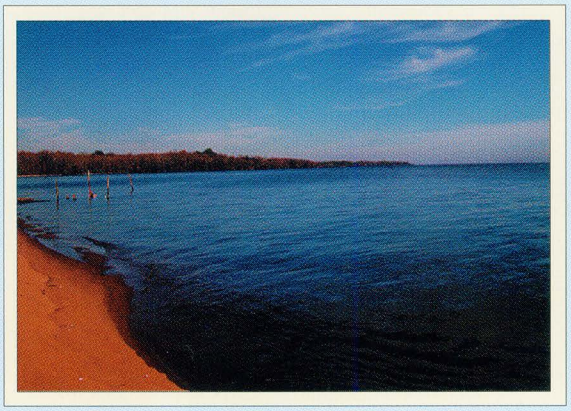
Ground-water studies of NAWQA are composed of three components: (1) Study-unit survey, (2) Land-use survey, and (3) Flow-path study. All three components emphasize the study of shallow aquifer systems. Water samples are analyzed for major ions, nutrients, pesticides, and volatile organic compounds. Radiochemicals such as radium and uranium isotopes and radon are included in the study-unit survey.

The study-unit survey is intended to characterize general baseline water quality and does not target specific land uses. The land-use survey attempts to characterize water quality associated with particular land uses. About 20-30 wells randomly selected to be sampled throughout the Coastal Plain are used for each study.

The Albemarle-Pamlico Study Unit is designed to characterize effects of corn-soybean agriculture and urban activities on shallow ground-water quality. Results from the land-use survey can be used to compare with results from the general study-unit survey. Synoptic studies also are conducted to address particular questions about ground-water quality over large areas.



The flow-path study is intended to answer important questions about processes controlling ground-water contamination. Several wells along a flow path are installed and sampled for various chemicals. Records of pesticide and fertilizer applications are obtained to relate findings in water quality with land-use practices. Other factors, such as geology and soil and aquifer chemistry, are considered to distinguish human from non-human factors affecting ground-water and surface-water quality.



Pamlico Sound...

For additional information, contact the following:

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